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NATURAL GAS IN A CHANGING MARKET

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«Natural gas and energy security»

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NATURAL GAS AND ENERGY SECURITY

1. Introduction

The International Energy Agency, which is a semi-autonomous body within the OECD, was set up in 1974 in the wake of the first oil crisis to safeguard oil supplies to the member countries, which with a couple of exceptions are the same as the member countries of the OECD. Since then, its scope has broadened in that the IEA today is expected to look after security of supply for all energies including natural gas. In 1993, the Agency was requested by OECD energy ministers to make an enquiry into all aspects of gas security of supply. This request resulted in a 560-page report to ministers and later on an official publication in the autumn of 1995.

The main conclusion of the report is that, in the present institutional context, IEA countries in general are well placed to withstand potential disruptions in gas supply, whatever the origin. However, careful monitoring will be required to ensure that the appropriate level of security protection is maintained as gas demand grows. In addition, some countries which rely mainly on single sources of supply or are still developing their gas infrastructure need to consider further measures to improve their security. The projected growth in gas demand does not in itself constitute a security problem - supplies are potentially available, but international cooperation and a stable framework for investment and trade are needed to encourage the long term commitments necessary to develop the needed supplies.

Gas security is best seen in terms of risk management. Risk management is central to the gas business and is primarily a matter for gas companies and their customers. There is nonetheless a role for Governments in setting a framework within which risks can be effectively managed and sometimes in determining the acceptable level of system risk. In this context it should of course not be ignored that agreements for cooperation in cases of emergency already exist between a number of major European gas companies. This is why our study did not identify any obvious need for a supranational gas sharing agreement along the lines of what already exists for oil supplies, an agreement which is administered by the IEA. But as I will point out below, the

European gas industry is probably headed towards more competition and structural changes as a consequence of that. It could therefore not be excluded that a need for international arrangements at a regional level may arise, and the IEA intends to look into this.

With these observations as background I will give you the highlights of our study, keeping to the following structure [**GRAPH 1**]: After clarifying the security of supply concept I will roughly describe the position of gas in the European energy picture before I give you our main results in terms of short term security of supply. I will then pass on to long term security issues before I round off by some conjectures about the future structure of European gas markets and possible consequences for security of supply.

2. Security of Supply - What is It?

Security of supply is a vague and woolly concept, and I could easily spend my allotted time discussing this alone. To clarify this very quickly I would just say that we have used the dictionary definition of security as the state of being safe against adverse contingencies. In relation to natural gas supply, the "adverse contingencies" are primarily those of a disruption to, or non-availability of, supply. Three broad classes of risk can be identified [**GRAPH 2**]:

- i) *Technical Risk*, e.g. that because of an accident, terrorist incident or natural catastrophe, a major supply facility is put out of action.
- ii) *Failure to Mobilise Long-term Supply Or Ensure Deliverability*. This describes the situation of "non-availability" of supply where gas demand or economic gas-consuming investment outpaces gas supply or gas-producing investment and deliverability.
- iii) *Political Risk*, including both the possibility of a disruption to an existing supply, for a shorter or longer period, for political reasons and the possibility that gas supplies which are economically available from a particular source will not be mobilised because the political risks are too high.

Gas security as discussed in our study involves protection against all these risks. Absolute security, in the sense that all those risks are reduced to zero for all consumers, is likely to be impossible, and certainly very expensive. Many customers will be prepared to accept some diminution in the security of supply in exchange for lower prices. Different classes of consumers may well make different trade-offs in this respect. Nonetheless they will all have a strong interest in seeing that their chosen level of security is actually achieved.

3. The Role of Gas on the European Energy Scene

Natural gas accounts for about 18% of the total primary energy consumption in OECD Europe. Roughly 72% of the total gas volumes consumed are imported from countries outside the region, the most important of which are Russia and Algeria. There are in fact few really captive markets for gas in the sense that in most gas uses other fuels can also be used. In security terms this means that gas in many cases can be substituted for by other fuels in case of a gas disruption. Roughly one third of the industrial gas demand in OECD Europe can be replaced by other fuels, primarily oil products, at short notice. These possibilities are also quite good in the power generation sector where little capacity is based exclusively on gas. Switching possibilities are much more limited in the residential/commercial sector, although it must be admitted that nobody really knows how big they are.

Gas has played a key role in reducing dependence on oil and will increasingly become the fuel of choice for environmental reasons, especially in the power generation sector. Concerns about long term availability of supply and increasing import dependence, however, motivated an enquiry into gas security.

4. Short Term Security of Supply

The point of departure for our analysis of short term security of supply is that no country in OECD Europe has ever been hit by a major disruption in gas supplies. Gas producers and exporters both within the OECD and outside have an excellent track record as far as reliability

is concerned. We have, however studied the possible effects of a number of disruption scenarios without speculating about their probability. I have chosen to show you the results of disruptions in Russian and Algerian supplies primarily because such disruptions would lead to a loss of larger volumes and would affect a bigger number of countries than other scenarios, for instance a simulation of a future disruption in supplies from the Troll platform.

The question we have tried to answer is the following: for how long could the gas companies go on supplying their firm customers in the cases of a complete disruption in supplies from Algeria or Russia under reasonable assumptions about utilisation of storage, interruptible contracts and flexibility under other contracts? The answer is indicated in [GRAPH 3]. We have studied the effect of the disruptions on two different assumptions: In the "worst case", no extra supplies are available under other import contracts and interruptible supplies are cut according to contract conditions. In the "best case", the countries hit by a disruption benefit from increased supplies under other supply contracts beyond the flexibility provided for in the contracts, and interruptible supplies are cut indefinitely.

The main message from this analysis is that countries like France, Germany and Italy are able to supply their firm customers for quite some time after the occurrence of a disruption. Germany could for instance theoretically go on supplying its firm customers almost indefinitely even in the case of a complete cutoff in Russian supplies. Countries like Spain and Turkey, however, would very quickly run into problems since they have very limited storage capacity. It should be stressed that these results are based on simulations of 1992 figures and that the situation has improved in both Spain and Turkey since then in that Spain now receives gas from Norway and that Turkey has opened an LNG terminal. It still remains the case, however, that some countries in the periphery of OECD Europe are quite vulnerable to supply disruptions.

The ability to switch to other fuels in the case of a gas supply disruption is of course important from an IEA perspective. We have therefore tried to find out what a disruption in Russian or Algerian gas supplies could lead to in terms of increased demand for other fuels. It turns out that the effect on heavy fuel oil demand would by far be the most important one. As this

graph [GRAPH 4] shows a disruption in Russian supplies could lead to an increase in Heavy Fuel Oil demand of half a million barrels per day, which is higher than the increase in demand caused by the UK miners' strike in the middle of the 1980s. As some of you may remember the relative price effects of that increase in demand were considerable. An interesting effect in this context is that higher fuel oil demand in Europe would probably lead to higher fuel oil prices generally which in North America could lead to decreased use of HFO and in turn a higher consumption of natural gas through fuel switching. So a gas supply disruption in Europe could lead to higher gas consumption in North America through the fuel oil price mechanism.

Today, gas consumption for power generation purposes is still relatively limited in OECD Europe. Of our 18 member countries in this region, only 6 had a gas share in power generation of 10% or more in 1993. Nowhere could the use of gas in power generation be considered a problem in security of supply terms, either seen from the gas industry's point of view or from the electricity industry's point of view. The reasons for this are that most of the time possibilities for power exchanges between countries and regions exist, that there is some surplus generation capacity in most countries, that most countries have a high share of multifired capacity and that there is close co-operation between gas and electricity companies in case of supply problems.

Our demand forecasts, however, implies that the dependence on gas in power generation will increase substantially in a number of our member countries over the next 15 years. By 2000, 14 countries are expected to have a gas share above 10%. In 7 of these countries the share could be more than 25%. Towards 2010, we could see some countries depending on gas for more than 35% of their power generation. The implications in terms of security of supply will have to be closely monitored. Should the market not provide adequate preparedness to counter supply problems, policy options like dual firing requirements, mandatory backup fuel storage and mothballing of retired capacity are possible measures to achieve this.

5. Long Term Security of Supply

The approach that we have taken to analyse long term security of supply is in principle very simple; based on demand forecasts up to 2010 we have looked into the need for new gas volumes over this period and where it might possibly come from and tried to analyse the issues arising in terms of costs, transit problems and diversification.

Since the major point in making demand forecasts here is to establish a background on which we can discuss future supplies, I shall not dwell on them, just mention that their most conspicuous feature is the strong growth in demand for gas to power generation, taking roughly 50% of total growth over the period, of about 70%.

My next graph shows both the total demand figures for OECD Europe and in principle how this demand could be covered [GRAPH 5]. According to forecasts from our member countries indigenous production for local use could increase slightly over the period, but will account for a declining share of total supplies over time, going down from about 47% in 1992 to around 30% in 2010. The other side of the coin is of course that supplies from other sources, both inside and outside the OECD Europe region, will increase correspondingly. The yellow part of the bars in the graph shows already contracted volumes. The contracts agreed will generally reach their plateau level between 2000 and 2005. When calculating the need for new gas contracts we have assumed that existing contracts will be extended at their plateau level beyond 2010. The need for gas in 2000 has already basically been covered but some 60 bcm are still needed to satisfy demand in 2010.

The crucial questions in this context are of course where this new gas could come from and at what cost. As this map [GRAPH 6] shows there are abundant gas reserves both in countries that traditionally have supplied Europe and in countries that potentially could supply Europe. Generally, Europe will increasingly be forced to take gas from more remote sources which in principle would imply increasing supply costs. With assistance from an external institution we have tried to illustrate this by establishing a supply cost curve [GRAPH 7]. The

supply cost curve concept is a very static one; I shall come back to this in a minute but I still think it can be used to illustrate a couple of points. The graph shows a number of supply options and their associated cost. Its major message is that at a gas price corresponding to an oil price of USD 28/b (indicated by the upper blue line in the graph), there is in principle no supply problem. At a gas price corresponding to an oil price of USD 18/b (indicated by the lower blue line, however, it would apparently be very difficult to bring the needed gas volumes to the market. So, in a world where oil prices stay at today's level and the strong link between oil prices and gas prices remains, the gas industry is faced with a challenge and all the more since the evidence seems to be that of a decline in prices when competition is introduced. Having said that, it is our perception that costs are not static. All along the gas chain from wellhead to burner tip there is a potential for cost reductions. Recent studies in both the UK and Norway have shown that considerable costs reductions in production are possible. As a recent IEA study on gas transportation shows, however, the transportation cost part of the final end user price is much higher than that of production, which means that special efforts are needed in this area. The green shaded area in this graph shows the reduction in total cost of reducing the required rate of return on the transportation part of the supply projects from 15 to 10%. The required rate of return could often be reduced by reducing the perceived risk associated with the project. In some cases perceived risk could be reduced by establishing a stable legislative and institutional framework for trade and investment. It is our hope that the Energy Charter Treaty, containing provisions intended to facilitate transit of gas, will be a significant step in that direction. In a case where high supply costs really turn out to be a problem, delinking of the gas price from the oil price might be a solution for some buyers, for instance electricity producers.

With these considerations in mind we have tried to establish what could be the future European supply situation, illustrated by this graph [GRAPH 8]. It should be underlined that this is of course only one possible way of covering demand. In this particular scenario we have assumed that supplies from the North Sea will remain competitive and that the market will give it priority. In volume terms this means that some 80 to 90 bcm could come from Norway and around 20 bcm for the UK to the Continent towards the end of the period. Total gas production in OECD Europe will increase, but its share of demand will decrease from 69% in 1992 to 60%

in 2010. In terms of market shares, Norway will gain and the Netherlands will lose. Dependence on Algeria and Russia will not change dramatically; their total market share will only increase from 31% to 33% under this scenario. Russia is probably the country having the largest potential for increase in deliveries and is considered as a kind of marginal producer in that it could be likely to contribute significantly to satisfying demand in a scenario where this turns out to be higher than suggested above, or supplies from other sources lower.

6. Future Structural and Regulatory Developments and Possible Implications for Security of Supply

The European gas industry has undergone both structural and regulatory changes over the past 15 years, which in terms of security of supply have probably led to improvements. We believe that the development over the next 15 years will be even more dramatic as the market is probably headed for more competition driven both by regulatory changes and market forces. There are strong indications that Europe might undergo a development which to some extent will be similar to the developments observed in North America and in parts of the Asia/Pacific region, which, if it is possible to characterise it in two words, means deregulation and the introduction of competition.

The main conclusion from our work on North America is that market liberalisation seems to have affected central indicators of security of supply like gas deliverability, infrastructure development and price responsiveness on the whole positively. This graph [GRAPH 9] is an attempt to show some of the trends in the North American market since 1985.

In the upstream part of the gas chain deregulation has meant a shift in the way of looking at the reserve/production ratio. A "tin on the shelf" concept has been replaced by a "just in time gas" concept, which reduces upstream cost. The number of wells has increased over the period, and supplies have become geographically more diversified. Capacity utilisation in the delivery system has gone up. It may sound strange that this has improved security of supply: the reason

is that maintenance on spare capacity was formerly inadequate; it was therefore often not available when needed.

In the midstream, or transmission part of the gas chain, capacity utilisation has also gone up. Seen over the period since 1985 as a whole, pipeline construction has expanded considerably in spite of introduction of mandatory TPA. There has been a sizeable increase in pipeline capacity from Canada to the US and vice versa. Storage construction has increased, especially in Canada. Storage is now used differently compared to the situation a few years ago, some of the factors being unbundling, transition to daily balancing on pipelines and use of storage to speculate on price changes. The expansion of storage capacity relative to total consumption obviously is positive in terms of security.

In the downstream part of the gas chain reliability of supplies has increased. Buyers obtain the contract they want concerning duration and price responsiveness. Price responsive markets mean that gas is allocated to those who need it most during a shortage. Canada is probably the most advanced country in the world when it comes to letting end users even in the residential/commercial sector benefit from competition in gas supply. It is interesting to note that Canadian experience suggests it is possible to find practical solutions to the issue of who should be the supplier of last resort.

The North American gas delivery system was put to a very severe test in the winters of 1994 and 1996 and passed them very well, in spite of the fact that TPA and unbundling are now part of the organisational framework. We believe that some of the experience from North America in this area is of a general nature and therefore relevant for Europe. Nevertheless there are of course important differences between North America and Europe that must be taken into account when discussing future changes and their implications for security of supply [GRAPH 10]:

- The number of supply sources is smaller and the potential for an increase in this number is more limited. Required investments to supply are generally bigger and take longer to come on stream.

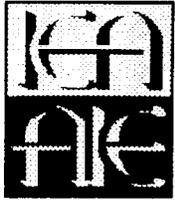
- Europe is dependent on external supply sources. These sources are not intrinsically less secure than indigenous sources; historical experience supports this, but the buyers feel that they have less control and influence over such sources and therefore consider them more risky.
- The European market is less mature and more diverse. It basically consists of a core of six countries with relatively mature markets, accounting for 90% of total consumption, plus a number of smaller markets still in their infancy where the ability to expand infrastructure and diversification of supplies are probably more important than introducing competition.

Given the current debate concerning future changes in gas market regulation going on both within the European Union and within all the IEA member countries, it is of course impossible to predict with any precision what the European gas market will look like 10 or 15 years hence. The IEA is not in the business of forecasting this, but it is of course concerned with the possible implications for security of supply of structural and regulatory changes taking place. This graph [GRAPH 11] shows some of the tendencies that could characterise the future European gas market:

- Easier access to transportation is the key to the introduction of effective competition in both ends of the gas chain. Easier access for third parties to pipeline capacity could contribute to lower unit transportation cost. It could be achieved by granting third party access or by granting liberty to build pipelines.
- Large industrial consumers and power producers might want to buy gas directly from producers once the physical possibilities for this are in place. Easier access to transportation may in fact be one of the prerequisites for a major breakthrough for gas in power generation.

- Easier access to transportation would probably lead to a bigger number of suppliers coming on to the market as in the UK, although the physical possibilities for this in Europe are limited. Easier access to transportation in countries like Russia and Algeria could have the same effect.
- Competition in the gas retail sector, including the residential sector along the lines attempted in Canada and now being experimented in the UK cannot be excluded in other countries. Experience from Canada suggests that the security issues raised by such competition can be solved by defining the responsibility for ultimate supply and establishing backup facilities.
- In recent years we have witnessed a tendency towards both horizontal and vertical integration in the European gas industry. The most conspicuous example of vertical integration is perhaps Gazprom's joint ventures with local companies in a number of European countries. Another interesting tendency is the combined horizontal and vertical integration undertaken by major power producers like National Power and PowerGen. These trends towards integration will probably continue, which from a security point of view would be positive. The observed trend towards integration may, in some cases, be the first step towards the emergence of new gas aggregators.
- Also in Europe there is a potential for the creation of market hubs, that is market centres where several pipelines come together. Easier access to pipelines combined with a temporary surplus of gas could lead to the advent of spot markets for gas.

Generally it is difficult to see that the tendencies indicated above would be likely to affect security of supply negatively. Since, however, it is difficult to say with certainty today what will happen to the gas market structure in Europe over the next 20 years and to predict the effect of such changes on security of supply, the IEA will carefully monitor the market and, if necessary, come up with proposals as to how adverse developments in terms of security could be counteracted.



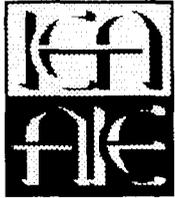
Natural Gas and Energy Security

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Stavanger, Norway: 27-30 August 1996

The views expressed in this paper are those of the author. They do not necessarily reflect the official position of the International Energy Agency or of the governments of its Member countries.



Structure of the presentation

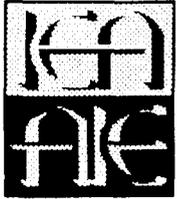
- ▶ Definition security of supply
- ▶ The role of gas on the European energy scene
- ▶ Short-term security of supply
- ▶ Long-term security of supply
- ▶ Future structure of European gas markets - possible consequences for security of supply



Three Broad Classes of Risk:

- ▶ **Technical Risk**
- ▶ **Failure to mobilise long-term supply or ensure deliverability**
- ▶ **Political risk**

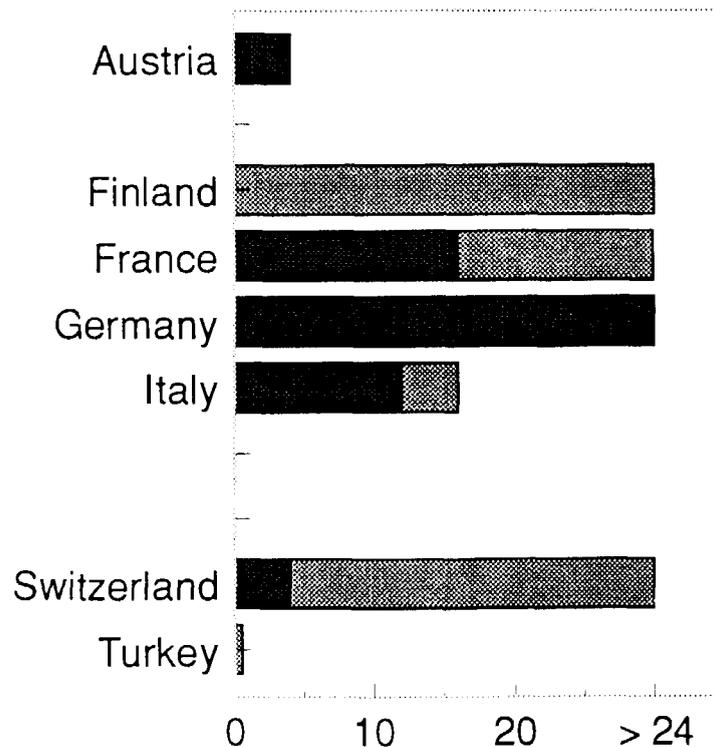




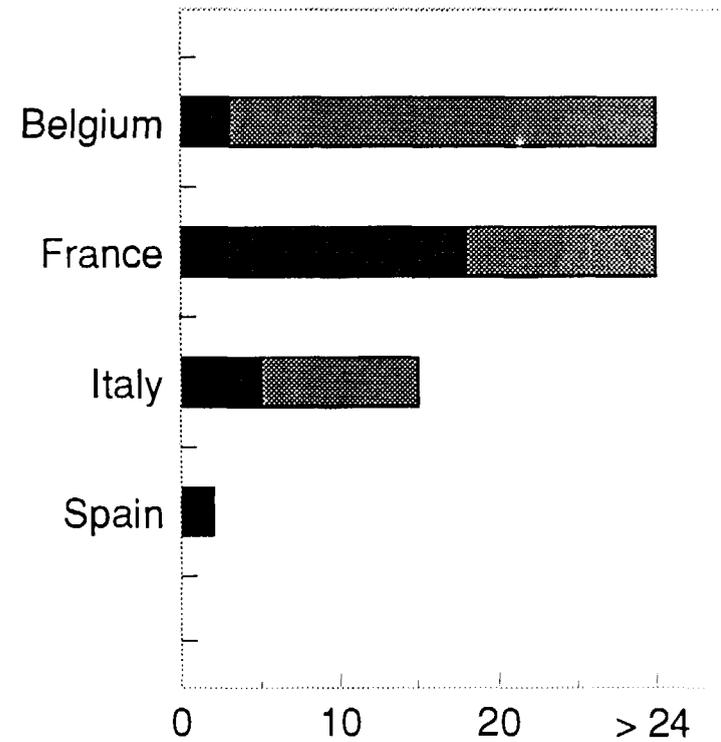
Effects of Supply Disruptions

(Months before firm sales are cut)

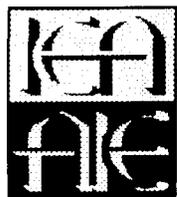
Russian Disruption



Algerian Disruption



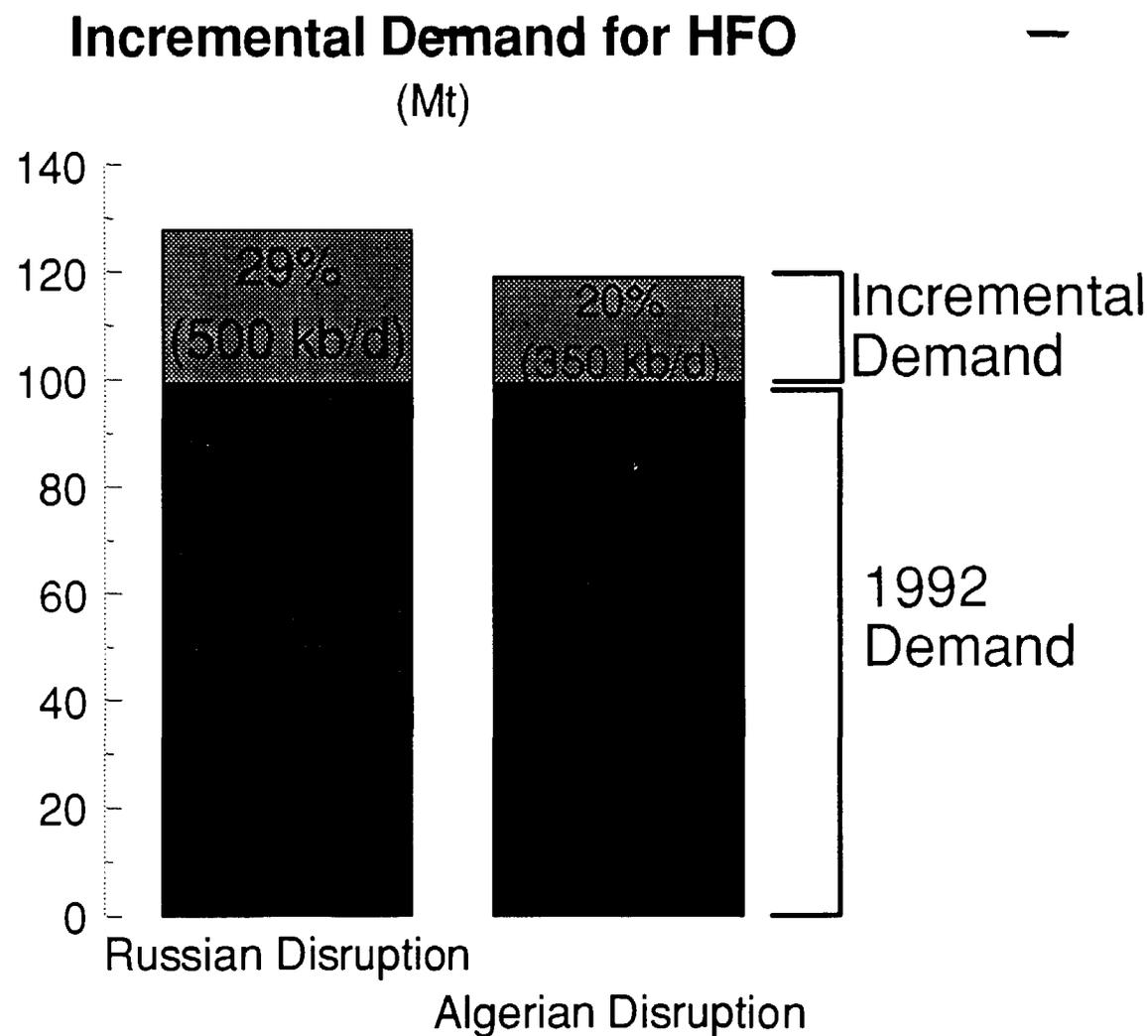
■ Worst Case ■ Best Case

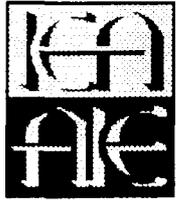


Effects of Disruptions on Other Fuels

(OECD Europe)

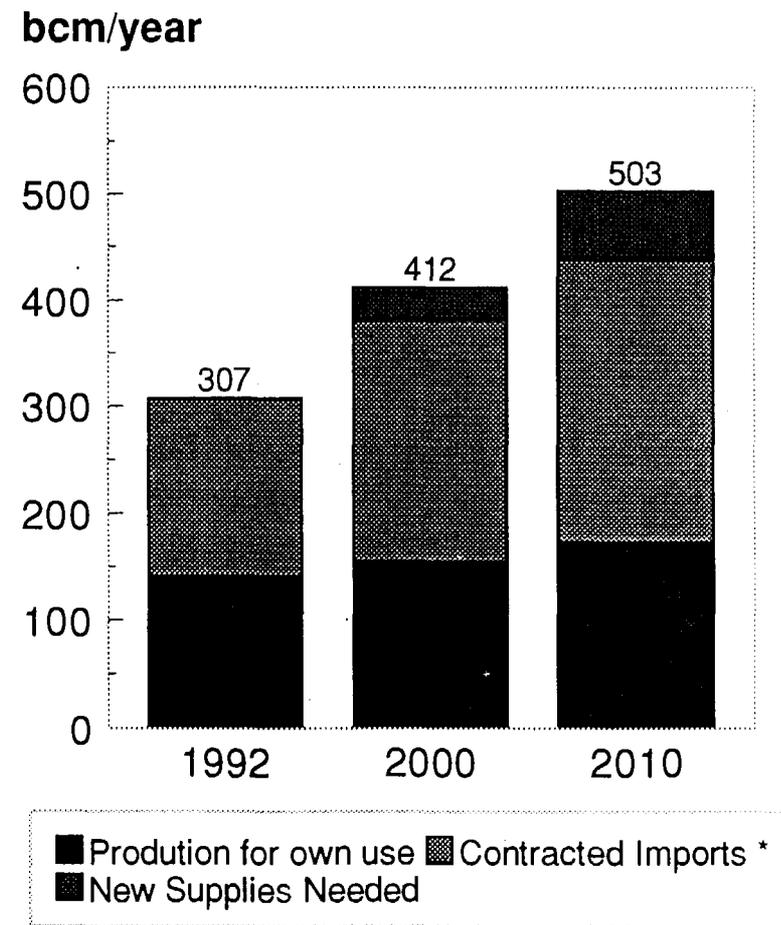
- Substitution fuels
 - mainly Heavy Fuel Oil
- UK miners' strike
 - + 380 kb/d HFO demand
 - HFO price up by \$3.80/b
 - Gasoil/HFO differential down from \$7.40/b to \$2.10/b





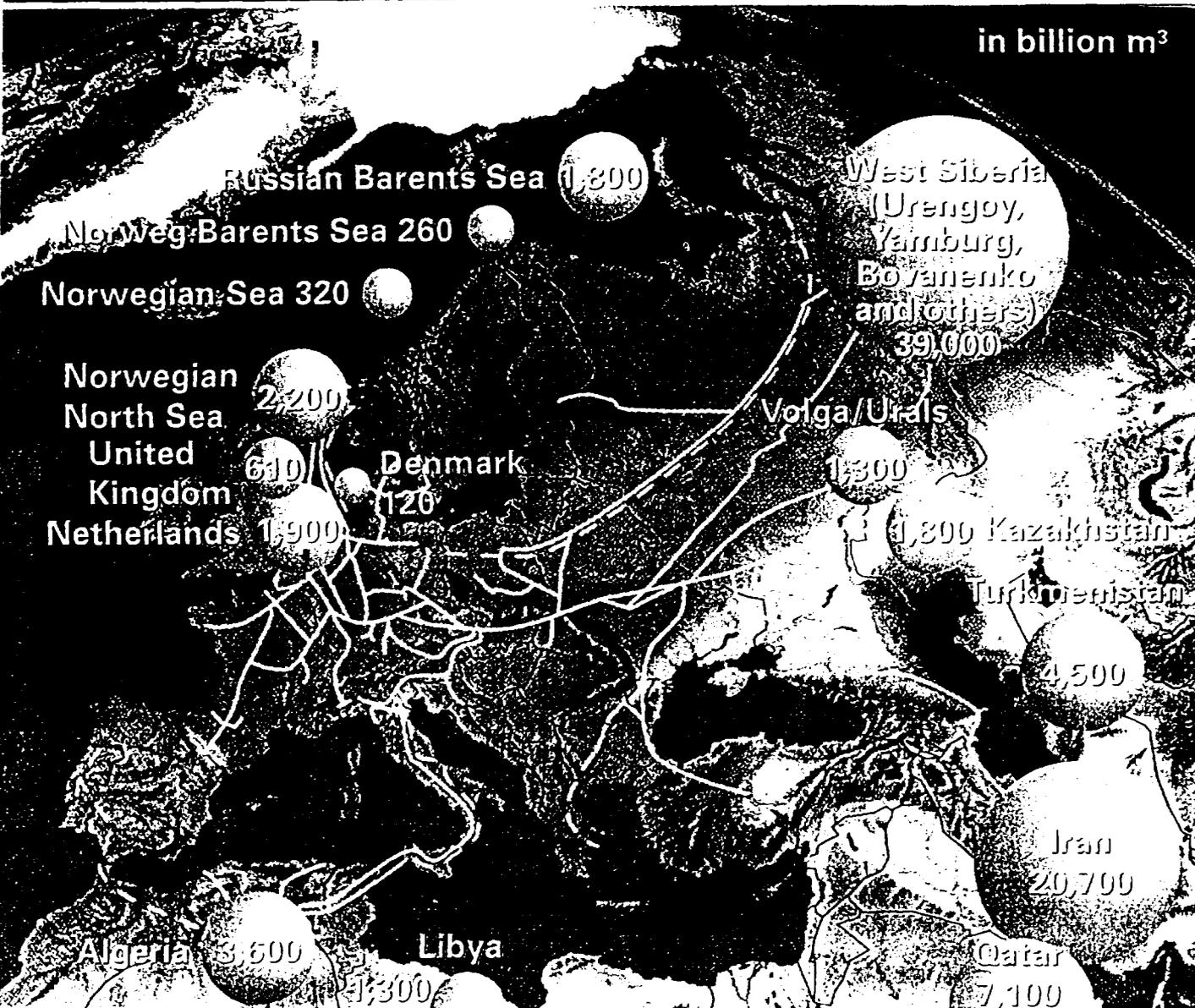
OECD Europe: Sources of Gas

- Indigenous production increasing slightly.
- Demand in 2000 basically covered.
- 170 bcm needs to be contracted by 2010 - 110 bcm from contract extensions and 60 bcm from new contracts.

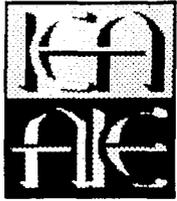


* Assumes contract extensions

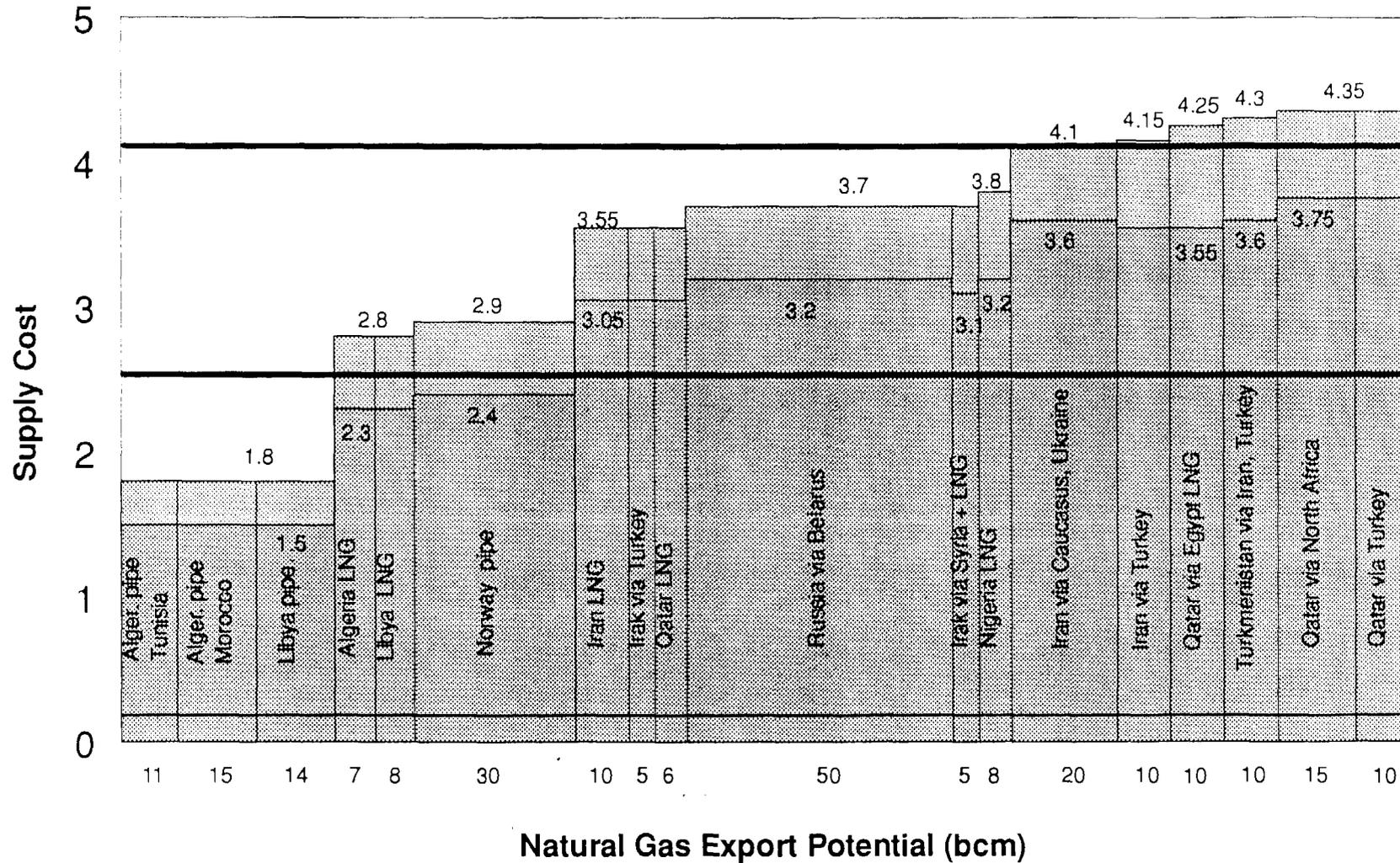
Gas Reserves in Countries with Export Potential for the European Market



Basic Map is reproduced from THE TIMES ATLAS OF THE WORLD, COMPREHENSIVE EDITION, with kind permission of Times Book

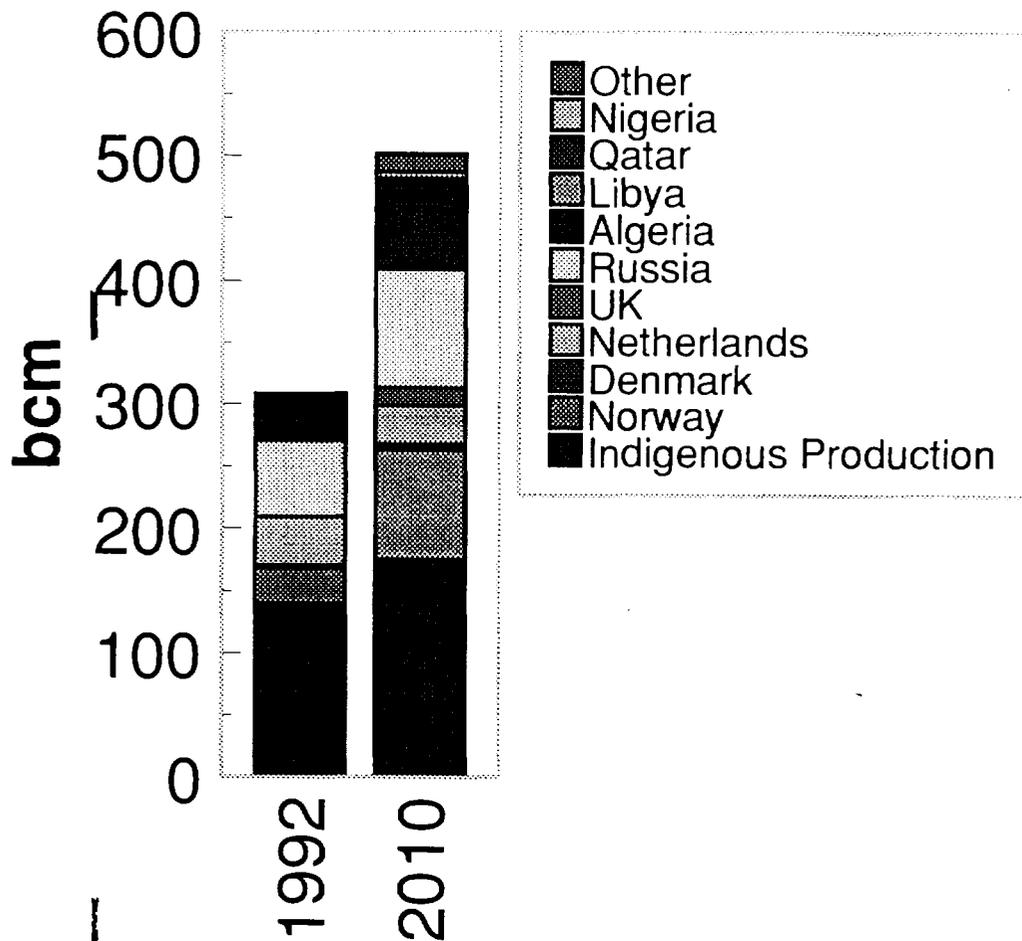


Possible Supplies to Europe & Costs (\$/MMBtu)

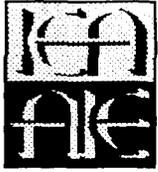




Possible Future Supplies



- OECD Europe production - down from 69% of demand in 1992 to 63% in 2010
- Reliance on Russia & Algeria:
 - 31% in 1992
 - 33% in 2010
- Higher demand scenarios could imply increased dependence on Russia



9a

MARKET LIBERALISATION AND SECURITY OF SUPPLY:

North American Experience

UPSTREAM:

- Shift from "tin on the shelf" to "just in time gas".**
- Increase number of wells, geographically more diversified supplies.**
- Higher capacity utilisation in delivery system.**



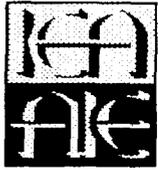
MARKET LIBERALISATION AND SECURITY OF SUPPLY:

9b

North American Experience

MIDSTREAM:

- Increased pipeline capacity utilisation.**
- Increase in pipeline construction, more interconnection Canada/US and vice versa.**
- Increase in storage construction.**
- Different use of storage.**

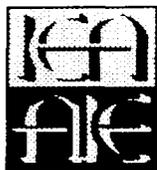


MARKET LIBERALISATION AND SECURITY OF SUPPLY:

North American Experience

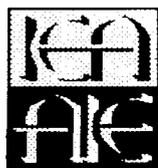
DOWNSTREAM:

- Increased reliability of gas supplies.**
- Buyers obtaining the contracts they want.**
- Price responsive markets mean that gas is allocated to those who need it most.**
- Possible to find solution to "supplier of last resort" issue.**



DIFFERENCES BETWEEN NORTH AMERICA AND EUROPE

- NUMBER OF SUPPLY SOURCES SMALLER AND POTENTIAL FOR INCREASE MORE LIMITED IN EUROPE
- EUROPE IS DEPENDANT ON EXTERNAL SUPPLY SOURCES
- EUROPEAN MARKET IS LESS MATURE AND MORE DIVERSE



POSSIBLE FUTURE CHARACTERISTICS OF THE EUROPEAN GAS MARKET

- EASIER ACCESS TO TRANSPORTATION

- LARGE INDUSTRIAL CONSUMERS AND POWER PRODUCERS WANT TO BUY DIRECTLY

- BIGGER NUMBER OF SUPPLIERS

- MORE HORIZONTAL AND VERTICAL INTEGRATION

- COMPETITION IN RESIDENTIAL/COMMERCIAL SECTOR

- POTENTIAL FOR CREATION OF MARKET HUBS